NISTTech

Mixing Liquids & Entrainment Mixing of Vapor into Liquids

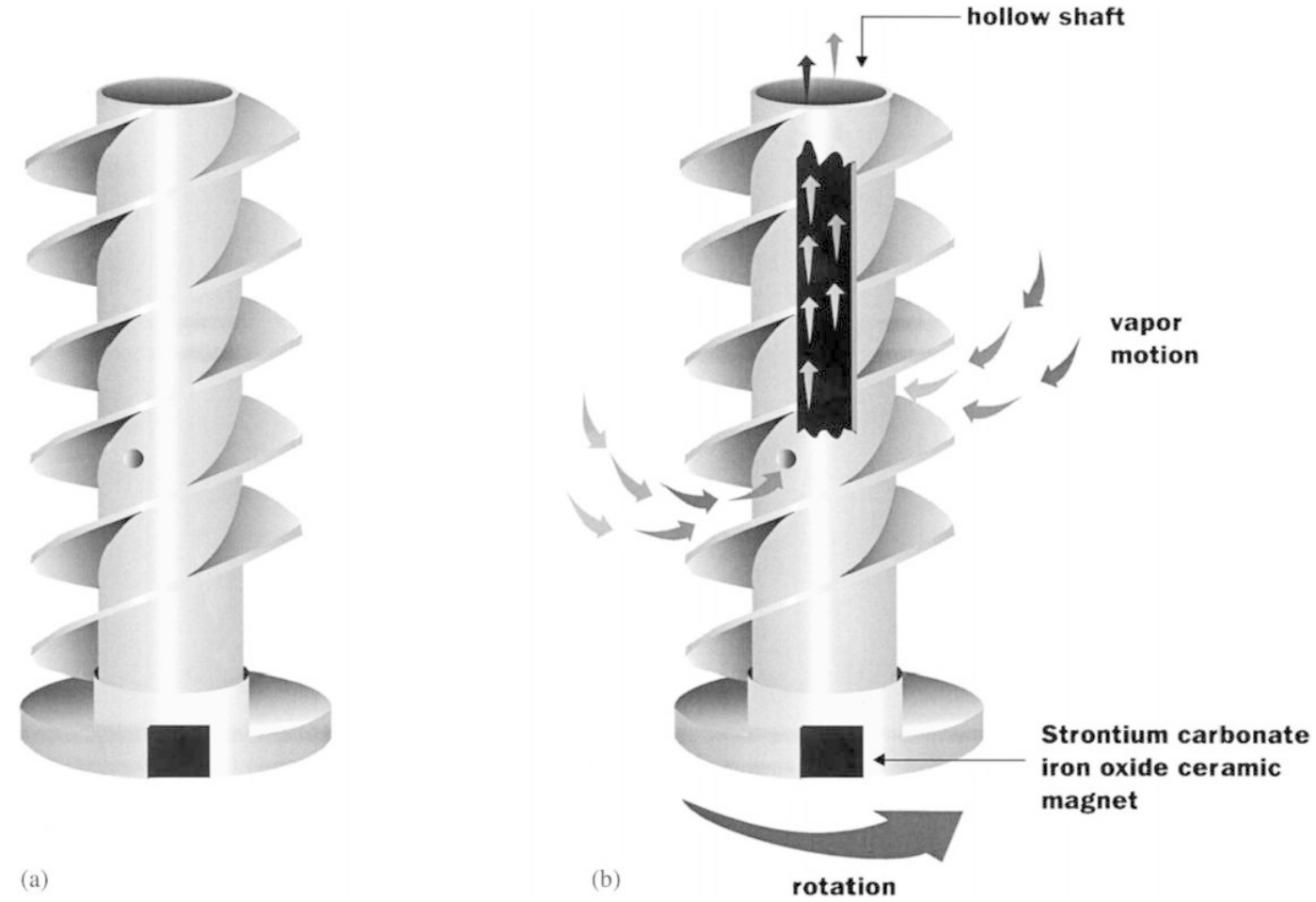
Scalable, rapid mixing of liquid and gas/vapors across a range of temperatures

Description

Gas and liquid won't mix? New NIST device maybe the answer. Mixing ingredients for a cake or a batch of cookies is a pretty simple matter. Mixing in industry is often more difficult. For example, mixing a gas into a liquid is typically a complicated procedure. Now, NIST researchers have developed a new device that can do the job in a matter of seconds rather than hours. Developed to improve measurements for the gas industry, the new mixer uses a hollow rotor shaped like a double helix. The rotor is placed in a closed container filled with the desired liquid and gas is pumped through it. An external magnetic field spins the rotor and the gas circulates through strategically placed holes, allowing quick distribution throughout the liquid.

The mixer also has been used for facilitating chemical reactions and for extractions such as removing heavy metals from water, an application with important environmental implications. Mixing of fluids is an integral component in innumerable operations in chemical processing, both for industrial and research applications. Countless instances require mixing of reactants in large-scale stirred chemical reactors in order to optimize blend times and minimize power consumption. On smaller scales in scientific instrumentation, many applications incorporate a fluid mixing operation. These include, for example, measurement apparatus for vapor liquid equilibrium, and for liquid-phase kinetics measurements. Moreover, numerous analytical procedures require the mixing of reagents and reactants in a controlled, closed environment to complete a chemical measurement.

Images



Credit: NIST

Applications

- **Laboratory mixing**
  Simplifies and drastically reduces the time required for mixing vapors and liquids.
- **Chemical reactions**
  Provides another manner for facilitating chemical reactions in laboratories.
- **Extractions**
  Separate substances from each other, for example heavy metals from water.

Advantages

- **Reduces mixing time**
  Shortens the time needed to mix vapors and fluids from hours to minutes.
- **Scalable and versatile**
  Functions at various scales and with many materials.
- **Controlled, closed environment**
  Provides the ideal controlled environment for many types of reactions.

Abstract

Disclosed is a fluid mixer that mixes liquids while simultaneously promoting rapid mixing entrainment of vapor in the liquid. The device includes a vertical rotor mounted centrally on a base assembly. The rotor comprises a tube which is hollow from an open top end to a bottom closed end, having an external screw thread in a right-side configuration relative from top to bottom and one or more holes located in the sidewall of the tube at the bottom of the hollow portion of the tube, preferably located centrally between two flanking surfaces of the screw thread. The base assembly comprises a stirbar and a supporting disk which contains a ceramic magnet. The base rests on the floor of a containment vessel. A magnetic stirring motor is centrally located sufficiently close to and beneath the containment vessel as to achieve magnetic flux coupling with the base magnet. Operation of the mixer develops a liquid vortex in the liquid phase material. As the speed increases, the external screw threads generate turbulence and draw vapor into the liquid from above the tube and urge the vapor into intimate contact with the turbulent, droplet-forming liquid. A circulation develops causing a vortex to develop. As the speed of circulation increases, the surface of the liquid is lowered until it matches the hole in the sidewall of the tube. The liquid enters the holes in the sidewall of the tube along with entrained vapor, and rises through the liquid in the hollow tube, and exits the open top end.

Inventors

- Bruno, Thomas J.
- Rybowiak, Michael C.

Citations

1. T.J. Bruno and M.C. Rybowiak. Vapor entraining magnetic mixer for reaction and equilibrium applications. Fluid Phase Equilibria 178 pp. 271–276, 2001.

References

- U.S. Patent # 6,585,405 issued , expires 05/17/2021
- Docket: 00-016US

Status of Availability

active patent and available for licensing
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